

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of

Hirotsugu FUKUOKA

Prior

Group Art Unit: 3748

Serial No.: Rule 1.53(b) Div.
Appln. of 09/564,647
filed May 3, 2000

Prior

Examiner: John Vrablik

Filed: April 27, 2001

For: REFRIGERATING CYCLE OR COMPRESSOR
HAVING FOREIGN MATTER COLLECTOR

PRELIMINARY AMENDMENT

Commissioner for Patents
Washington, D.C. 20231

Sir:

Prior to examination of the above-identified Rule 1.53(b)
divisional application, please amend the application as follows:

IN THE SPECIFICATION:

Page 1, second paragraph to page 2 paragraph continued,
replace with the following:

A conventional refrigerating cycle is described by referring
to Fig. 11. In Fig. 11, reference numeral 101 shows a compressor.

The refrigerant compressed in the compressor 101 is condensed in a condenser 102. The refrigerant expanded in a throttling unit 103 is evaporated in an evaporator of 104, and cooling is effected by evaporation latent heat.

When operating such a refrigerating cycle, foreign matter mainly composed of iron powder and copper powder mixed at the time of assembly is likely to deposit in the throttling unit 103 where the flow velocity of the refrigerant is slow and the passage area is narrow. Moreover, worn powder from the sliding parts of the compressor and carbides due to deterioration of refrigerating machine oil also deposit in the throttling unit 103. As a result, the sectional area of the throttling unit 103 becomes gradually narrower, the throttling rate becomes larger, and the compression ratio of the high pressure side and low pressure side becomes higher. Accordingly, the temperature of the refrigerant discharged from the compressor is raised, the abrasion of the sliding parts is further promoted, and clogging of the throttling unit 103 with worn powder is increased, thus falling in a spiral. Therefore, the reliability of the refrigerating cycle is spoiled extremely.

Page 3, third paragraph to page 4 paragraph continued, replace with the following:

It has been recently disclosed that these refrigerants, when released in the atmosphere, destroy the ozone layer and have serious effects on the human health and ecological system, and therefore the use of CFC12 or HCFC22 is being limited in gradual steps, and there is an international agreement to abolish them completely in the future.

Page 4, first paragraph, replace with the following:

This is because the chlorine atom, one of the elements composing the conventional refrigerant such as CFC12 and HCFC22, reacts with the iron atom in the metal material and forms a wear resistant iron chloride film. By contrast, when using HFC134a, HFC125, or HFC32 as refrigerant, since chlorine atom is not present in these refrigerants, lubricating film such as iron chloride film is not formed, which is one of the causes of lowering of lubricating action.

Page 6, first paragraph to page 9 paragraph continued, replace with the following:

In an embodiment of the invention, a connection piping in a coil shape is provided in at least front part or rear part of a throttling unit, a fine pipe is connected to the lower part of this connection piping, and a collector for collecting foreign matter in the refrigerating cycle is coupled to the leading end of this fine pipe.

In another embodiment of the invention, a fine pipe is connected to a connection piping provided in at least front part or rear part of a throttling unit, the center line of the fine pipe is inclined at 90° or less in the flowing direction of the refrigerant, and a collector is coupled to the leading end of the fine pipe.

In another embodiment of the invention, a rotary plate twisted in the spiral direction is provided in the piping for composing a refrigerating cycle, a fine pipe is connected to the piping at the downstream side of this rotary plate, and a collector is attached to the leading end of the fine pipe.

In another embodiment of the invention, relating to a compressor having a compressing mechanism incorporated in an enclosed container, a recess having an action of collecting foreign matter is provided at the inside of the lowest portion of the

enclosed container.

In an embodiment of the invention, relating to a compressor having a compressing mechanism incorporated in an enclosed container, a muffler is provided at the discharge part of compressed refrigerant, and a communication path curved in the circumferential direction is provided in the discharge hole of the muffler, a fine pipe is connected to the outside of the communication path, and a collector is coupled to the leading end of the fine pipe.

In another embodiment of the invention, a fine pipe inclined at 90° or less in the flowing direction of refrigerant is connected to a discharge pipe for discharging compressed refrigerant, and a collector is coupled to the fine pipe.

In another embodiment of the invention, a fine pipe inclined at 90° or less in the flowing direction of refrigerant is connected to a discharge pipe for discharging compressed refrigerant, the fine pipe is connected to the inlet of a collector, a filter is provided in the collector, a bypass pipe is coupled to the other outlet of the collector, and the leading end of the bypass pipe is coupled with the discharge pipe.

In another embodiment of the invention, a compressing

mechanism includes a rotary shaft for transmitting rotation, and an upper bearing and a lower bearing for supporting the rotary shaft, an oil feed path is provided in the upper bearing and lower bearing for the purpose of lubrication, and a collector inclined at an angle of 90° or less in the flowing direction of lubricating oil and closed at the leading end is provided in the oil feed paths.

In another embodiment of the invention, relating to a compressor used in refrigerating or air-conditioning system, using chlorine-free hydrofluorocarbon used as refrigerant either alone or in mixture, and packing an enclosed container with refrigerating machine oil compatible with the refrigerant, a motor and a compressing mechanism are disposed in the enclosed container, the compressing mechanism includes a rotary shaft for transmitting rotation of the motor, an oil feed pump is provided in the rotary shaft, a communication hole for feeding refrigerating machine oil to necessary parts is formed, a passage extending downward to the communication hole is provided, and the other end of the passage is closed.

In another embodiment of the invention, relating to a compressor used in refrigerating or air-conditioning system, using chlorine-free hydrofluorocarbon used as refrigerant either alone or

in mixture, and packing an enclosed container with refrigerating machine oil compatible with the refrigerant, a motor and a compressing mechanism are disposed in the enclosed container, the motor includes a stator and a rotor, the rotor has a rotary shaft for transmitting rotation to the compressing mechanism, the rotary shaft has a oil feed pump, an oil feed path for feeding refrigerating machine oil to sliding parts is further formed in the rotary shaft, the oil feed path and one end of a fine pipe are connected, and the leading end of the fine pipe and a collector provided in the rotor are connected with each other.

Page 10, fifth paragraph to page 14, second paragraph, replace with the following:

According to a preferred embodiment of the invention, a coil shaped connection piping is provided in at least front part or rear part of a throttling unit, a fine pipe is connected to the lower part of this connection piping, and a collector for collecting foreign matter in the refrigerating cycle is coupled to the leading end of this fine pipe, whereby worn powder or the like is collected in the collector through the fine pipe by centrifugal force.

According to another embodiment of the invention, a fine pipe is connected to a connection piping provided in at least front part

or rear part of a throttling unit, the center line of the fine pipe is inclined at 90° or less in the flowing direction of the refrigerant, and a collector is coupled to the leading end of the fine pipe, whereby worn powder or the like is collected in the collector through the fine pipe by flow velocity of the refrigerant.

According to another embodiment of the invention, a rotary plate twisted in the spiral direction is provided in the piping for composing a refrigerating cycle, a fine pipe is connected to the piping at the downstream side of this rotary plate, and a collector is attached to the leading end of the fine pipe. In this constitution, from the refrigerant provided with a flow in the rotating direction, foreign matter such as worn powder is separated by centrifugal force, and is collected in the collector through the fine pipe.

According to another embodiment of the invention, relating to a compressor having a compressing mechanism incorporated in an enclosed container, a recess having an action of collecting foreign matter is provided at the inside of the lowest portion of the enclosed container, whereby foreign matter such as worn powder in the enclosed container is greater in specific gravity and is fenced

collected in the recess.

According to another embodiment of the invention, relating to a compressor having a compressing mechanism incorporated in an enclosed container, a muffler is provided at the discharge part of compressed refrigerant, and a communication path curved in the circumferential direction is provided in the discharge hole of the muffler, a fine pipe is connected to the outside of the communication path, and a collector is coupled to the leading end of the fine pipe, whereby the foreign matter in the discharge refrigerant is separated by centrifugal force, and is collected in the collector through the fine pipe.

According to another embodiment of the invention, relating to a compressor having a compressing mechanism incorporated in an enclosed container, a fine pipe inclined at 90° or less in the flowing direction of refrigerant is connected to a discharge pipe for discharging compressed refrigerant, and a collector is coupled to the fine pipe, whereby the foreign matter is separated from the refrigerant by the flow of the refrigerant, and is collected in the collector of foreign matter.

According to another embodiment of the invention, relating to a compressor having a compressing mechanism incorporated in an

enclosed container, a fine pipe inclined at 90° or less in the flowing direction of refrigerant is connected to a discharge pipe for discharging compressed refrigerant, the fine pipe is connected to the inlet of a collector, a filter is provided in the collector, a bypass pipe is coupled to the other outlet of the collector, and the leading end of the bypass pipe is coupled with the discharge pipe, whereby the foreign matter in the refrigerant is collected by the filter.

According to another embodiment of the invention, relating to a compressor having a compressing mechanism incorporated in an enclosed container, the compressing mechanism includes a rotary shaft for transmitting rotation, and an upper bearing and a lower bearing for supporting the rotary shaft, an oil feed path is provided in the upper bearing and lower bearing for the purpose of lubrication, and a collector inclined at an angle of 90° or less in the flowing direction of lubricating oil and closed at the leading end is provided in the oil feed paths, whereby foreign matter such as worn powder in the refrigerating machine oil is separated by difference in specific gravity, and is collected in the collector.

According to another embodiment of the invention, relating to a compressor used in refrigerating or air-conditioning system,

using chlorine-free hydrofluorocarbon used as refrigerant either alone or in mixture, and packing an enclosed container with refrigerating machine oil compatible with the refrigerant, a motor and a compressing mechanism are disposed in the enclosed container, the compressing mechanism includes a rotary shaft for transmitting rotation of the motor, an oil feed pump is provided in the rotary shaft, a communication hole for feeding refrigerating machine oil to necessary parts is formed, a passage extending downward to the communication hole is provided, and the other end of the passage is closed, whereby foreign matter such as worn powder in the refrigerating machine oil is separated by difference in specific gravity, and is collected in the passage.

According to another embodiment of the invention, relating to a compressor used in refrigerating or air-conditioning system, using chlorine-free hydrofluorocarbon used as refrigerant either alone or in mixture, and packing an enclosed container with refrigerating machine oil compatible with the refrigerant, a motor and a compressing mechanism are disposed in the enclosed container, the motor includes a stator and a rotor, the rotor has a rotary shaft for transmitting rotation to the compressing mechanism, the rotary shaft has a oil feed pump, an oil feed path for feeding

refrigerating machine oil to sliding parts is further formed in the rotary shaft, the oil feed path and one end of a fine pipe are connected, and the leading end of the fine pipe and a collector provided in the rotor are connected with each other, whereby foreign matter such as worn powder in the refrigerating machine oil is separated by difference in specific gravity, and is collected in the collector.

The claimed invention further enhances the collection of foreign matter by disposing a magnetic piece in the collector or the recess that collects foreign matter.

Page 15, first paragraph continuing on page 16, replace with the following:

Fig. 1 is a partial longitudinal sectional view of a cooling system in embodiment 1 of the invention. Herein, reference numeral 1 denotes a connection piping, which is provided in a front portion of a throttling unit 2 of a refrigerating cycle. However, the connection piping 1 may be provided also in a rear portion, or in both front portion and rear portion. The connection piping 1 is a coil shaped pipe, and a fine pipe 3 is connected at its lowest position, and a collector 4 is coupled to this fine pipe 3. In this constitution, when the refrigerant flows in the connection piping

1, foreign matter such as worn powder is guided into the collector 4 through the fine pipe 3 by the centrifugal force. By installing a magnetic piece 5 in the collector 4, the separating effect may be further enhanced. By thus collecting the foreign matter such as worn powder, clogging of the throttling unit 2 in the refrigerating cycle can be prevented, and rise of discharge temperature may be also avoided. Moreover, yet if worn powder is contained in the refrigerating machine oil, abrasion is further promoted in the sliding parts. By removing the worn powder, therefore, progress of wear can be retarded.

IN THE CLAIMS:

Please cancel claims 1, 2, 4, 5 and 15 without prejudice or disclaimer.

Please amend claims 12 and 13 as follows:

12. (Amended) A compressor of claim 8, wherein a magnetic piece is disposed in the collector.

13. (Amended) A compressor of claim 8, wherein hydrofluorocarbon is used as refrigerant, and a refrigerating machine oil compatible with the refrigerant is used.

REMARKS

This application is a Rule 1.53(b) Divisional Application of Serial No. 09/564,647, filed May 3, 2000.

Claims 3 and 6 to 14 are pending herein. Claims 1, 2, 4, 5 and 15 have been cancelled without prejudice or disclaimer.

The specification has been amended in the same manner as the parent application and to identify the parent application.

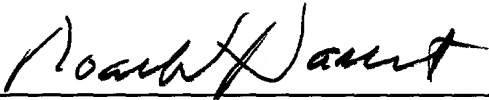
Filed herewith is an Information Disclosure Statement listing all references cited during prosecution of the parent application.

Prompt and favorable examination of this application on the merits is respectfully solicited.

Respectfully submitted,

PARKHURST & WENDEL, L.L.P.

April 27, 2001
Date



Roger W. Parkhurst
Registration No. 25,177

RWP/mhs

Attorney Docket No. YMOR:039C

PARKHURST & WENDEL, L.L.P.
1421 Prince Street, Suite 210
Alexandria, Virginia 22314-2805
Telephone: (703) 739-0220

SPECIFICATION

TITLE OF THE INVENTION

Refrigerating cycle or compressor having foreign matter collector

FIELD OF THE INVENTION

The present invention relates to a refrigerating cycle or compressor having a foreign matter collector for collecting foreign matter in a refrigerating cycle, for use in cooling apparatus, refrigerating apparatus, or air-conditioner.

BACKGROUND OF THE INVENTION

A conventional refrigerating cycle is described by referring to Fig. 11. In Fig. 11, reference numeral 101 shows a compressor. The refrigerant compressed in the compressor 101 is condensed in a condenser 102. The refrigerant expanded in a throttling unit 103 is evaporated in an evaporator 104, and cooling is effected by evaporation of latent heat.

When operating such a refrigerating cycle, foreign matter mainly composed of iron powder and copper powder mixed at the time of assembling assembly is likely to deposit in the throttling unit 103 where the flow velocity of the refrigerant is slow and the passage area is narrow. Moreover, worn powder from the sliding parts of the compressor and carbides due to deterioration of refrigerating machine oil also deposit in the throttling unit 103. As a result, the sectional area of the throttling unit 103 becomes gradually narrower, the throttling rate becomes larger, and the compression ratio of the high pressure side and low pressure side becomes higher. Accordingly, the temperature of the refrigerant discharged from the compressor is raised, the abrasion of the sliding parts is further promoted, and clogging of the

throttling unit 103 with worn powder is increased, thus falling in a spiral. Therefore, the reliability of the refrigerating cycle is spoiled extremely.

As the refrigerant for such refrigerating cycle, hitherto, dichlorofluoromethane (CFC12) or hydrodifluoromethane (HCFC22) has been mainly utilized. As the refrigerating machine oil to be packed in the compressor, naphthene or paraffin mineral oil having compatibility with CFC12 or HCFC22 has been used.

Since these refrigerants and refrigerating machine oils directly circulate within the compressor, the compressor mechanical parts are required to have wear resistance.

It has been recently disclosed that these refrigerants, when released in the atmosphere, destroy the ozone layer and have serious effects on the human health and ecological system, and therefore the use of CFC12 or HCFC22 is being limited in gradual steps, and ~~it has been decided to be abolished~~ there is an international agreement to abolish them completely in the future.

In such circumstance, substitute refrigerants have been developed, such as 1,1,1,2-tetrafluoroethane (HFC134a), pentafluoroethane (HFC125), hydrodifluoromethane (HFC32), and their mixed refrigerants.

These refrigerants HFC134a, HFC125, HFC32 are low in the coefficient of ozone destruction, but are hardly compatible with mineral oils which are refrigerating machine oils employed when using CFC12 or HCFC22. Hence, when using HFC134a, HFC125, HFC32 or their mixed refrigerants as the refrigerant of the refrigerant compressor, it has been attempted to use ester, ether or fluorine oil, compatible with these refrigerant, as the refrigerating machine oil.

As the refrigerating machine oil compatible with HFC134a, HFC125, HFC32 replacing the refrigerants CFC12

and HCFC22, polyalkylene glycol oil and polyester oil are known. In the case of the refrigerant compressor using such polyalkylene glycol oil and polyester oil, however, gray cast iron, special cast iron, and stainless steel used as the sliding materials in the compressor are lowered in wear resistance, and the refrigerant compressor cannot be operated stably for a long period.

This is because the chlorine atom, one of the elements composing the conventional refrigerant such as CFC12 and HCFC22, reacts with the iron atom in the metal material and forms a wear resistant iron chloride film. By contrast, when using HFC134a, HFC125, or ~~HFC32~~ HFC32 as refrigerant, since chlorine atom is not present in these refrigerants, lubricating film such as iron chloride film is not formed, which is one of the causes of lowering of lubricating action.

Moreover, in the conventional refrigerating machine oil derived from mineral oil, cyclic compounds were contained, and the oil film forming capability was relatively high, but the refrigerating machine oil compatible with HFC134a, HFC125, or HFC32 is mainly composed of chain compounds, and an appropriate oil film thickness cannot be maintained in severe sliding conditions, which also causes to lower the wear resistance.

Thus, in the refrigerant compressor using substitute refrigerant such as HFC134a, HFC125 or HFC32 instead of CFC12 or HCFC22, and employing refrigerating machine oil compatible with these refrigerants, the sliding condition is severe not only at high load but also at ordinary load, and abrasion of sliding members is increased. It was hence a more difficult problem than in the prior art to prevent clogging of the throttling unit in the refrigerating cycle.

Among refrigerating machine oils compatible with HFC refrigerant, polyester derivative refrigerating machine

oil undergoes decomposition of polyester due to hydrolysis or pyrolysis, and is bound with worn powder to produce iron soap. The iron soap is high in viscosity, deposits in the throttling unit in the refrigerating cycle, raises the discharge refrigerant temperature in the compressor, and further promotes wear, and the reliability of the refrigerating cycle is lowered by this spiral.

Still more, the refrigerating machine oil compatible with the HFC refrigerant is not compatible with the conventional mineral oil and is not used, but conventional mineral oil is used as machining oil when fabricating the compressor and heat exchanger. This mineral oil remaining in the refrigerating cycle is likely to deposit in the throttling unit which is slow in flow velocity and drastic in temperature changes. As a result, it leads to decline of reliability due to clogging of the throttling unit same as mentioned above.

DISCLOSURE OF THE INVENTION

The invention is devised to solve the above problems, and it is hence an object thereof to present a refrigerating cycle and a compressor enhanced in reliability and extended in service life by collecting foreign matter in the refrigerating cycle, in particular, when using HFC refrigerant.

In ~~claim 1~~ an embodiment of the invention, a connection piping in a coil shape is provided in at least front part or rear part of a throttling unit, a fine pipe is connected to the lower part of this connection piping, and a collector for collecting foreign matter in the refrigerating cycle is coupled to the leading end of this fine pipe.

In ~~claim 2~~ another embodiment of the invention, a fine pipe is connected to a connection piping provided in at least front part or rear part of a throttling unit, the center line of the fine pipe is inclined at 90° or less in

the flowing direction of the refrigerant, and a collector is coupled to the leading end of the fine pipe.

In ~~claim 3~~ another embodiment of the invention, a rotary plate twisted in the spiral direction is provided in the piping for composing a refrigerating cycle, a fine pipe is connected to the piping at the downstream side of this rotary plate, and a collector is attached to the leading end of the fine pipe.

In ~~claim 6~~ another embodiment of the invention, relating to a compressor having a compressing mechanism incorporated in an enclosed container, a recess having an action of collecting foreign matter is provided at the inside of the lowest portion of the enclosed container.

In ~~claim 8~~ an embodiment of the invention, relating to a compressor having a compressing mechanism incorporated in an enclosed container, a muffler is provided at the discharge part of compressed refrigerant, and a communication path curved in the circumferential direction is provided in the discharge hole of the muffler, a fine pipe is connected to the outside of the communication path, and a collector is coupled to the leading end of the fine pipe.

In ~~claim 9~~ another embodiment of the invention, a fine pipe inclined at 90° or less in the flowing direction of refrigerant is connected to a discharge pipe for discharging compressed refrigerant, and a collector is coupled to the fine pipe.

In ~~claim 10~~ another embodiment of the invention, a fine pipe inclined at 90° or less in the flowing direction of refrigerant is connected to a discharge pipe for discharging compressed refrigerant, the fine pipe is connected to the inlet of a collector, a filter is provided in the collector, a bypass pipe is coupled to the other outlet of the collector, and the leading end of the bypass pipe is coupled with the discharge pipe.

In ~~claim 11~~ another embodiment of the invention, a

compressing mechanism includes a rotary shaft for transmitting rotation, and an upper bearing and a lower bearing for supporting the rotary shaft, an oil feed path is provided in the upper bearing and lower bearing for the purpose of lubrication, and a collector inclined at an angle of 90° or less in the flowing direction of lubricating oil and closed at the leading end is provided in the oil feed paths.

In ~~claim 14~~ another embodiment of the invention, relating to a compressor used in refrigerating or air-conditioning system, using chlorine-free hydrofluorocarbon used as refrigerant either alone or in mixture, and packing an enclosed container with refrigerating machine oil compatible with the refrigerant, a motor and a compressing mechanism are disposed in the enclosed container, the compressing mechanism includes a rotary shaft for transmitting rotation of the motor, an oil feed pump is provided in the rotary shaft, a communication hole for feeding refrigerating machine oil to necessary parts is formed, a passage extending downward to the communication hole is provided, and the other end of the passage is closed.

In ~~claim 15~~ another embodiment of the invention, relating to a compressor used in refrigerating or air-conditioning system, using chlorine-free hydrofluorocarbon used as refrigerant either alone or in mixture, and packing an enclosed container with refrigerating machine oil compatible with the refrigerant, a motor and a compressing mechanism are disposed in the enclosed container, the motor includes a stator and a rotor, the rotor has a rotary shaft for transmitting rotation to the compressing mechanism, the rotary shaft has a oil feed pump, an oil feed path for feeding refrigerating machine oil to sliding parts is further formed in the rotary shaft, the oil feed path and one end of a fine pipe are connected, and the leading end of the fine pipe and a

collector provided in the rotor are connected with each other.

The many means for solving the problems mentioned above are suited to the refrigerating cycle or compressor using, in particular, hydrofluorocarbon as refrigerant, and using refrigerating machine oil compatible with this refrigerant.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is an essential longitudinal sectional view of refrigerating cycle in embodiment 1 of the invention,

Fig. 2 is an essential longitudinal sectional view of refrigerating cycle in embodiment 2 of the invention,

Fig. 3 is a longitudinal sectional view of compressor in embodiment 3 of the invention,

Fig. 4 is a plan view of muffler in embodiment 4 of the invention,

Fig. 5 is an essential longitudinal view in embodiment 5 of the invention,

Fig. 6 is a longitudinal sectional view of compressor in embodiment 6 of the invention,

Fig. 7 is a longitudinal sectional view of compressor in embodiment 7 of the invention,

Fig. 8 is a longitudinal sectional view of compressor in embodiment 8 of the invention,

Fig. 9 is a longitudinal sectional view of compressor in embodiment 9 of the invention,

Fig. 10 is a longitudinal sectional view of compressor in embodiment 10 of the invention, and

Fig. 11 is an explanatory diagram of a conventional refrigerating cycle.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

According to ~~claim 1~~ a preferred embodiment of the invention, a coil shaped connection piping is provided in at least front part or rear part of a throttling unit, a

fine pipe is connected to the lower part of this connection piping, and a collector for collecting foreign matter in the refrigerating cycle is coupled to the leading end of this fine pipe, whereby worn powder or the like is collected in the collector through the fine pipe by centrifugal force.

According to ~~claim 2~~ another embodiment of the invention, a fine pipe is connected to a connection piping provided in at least front part or rear part of a throttling unit, the center line of the fine pipe is inclined at 90° or less in the flowing direction of the refrigerant, and a collector is coupled to the leading end of the fine pipe, whereby worn powder or the like is collected in the collector through the fine pipe by flow velocity of the refrigerant.

According to ~~claim 3~~ another embodiment of the invention, a rotary plate twisted in the spiral direction is provided in the piping for composing a refrigerating cycle, a fine pipe is connected to the piping at the downstream side of this rotary plate, and a collector is attached to the leading end of the fine pipe. In this constitution, from the refrigerant provided with a flow in the rotating direction, foreign matter such as worn powder is separated by centrifugal force, and is collected in the collector through the fine pipe.

According to ~~claim 6~~ another embodiment of the invention, relating to a compressor having a compressing mechanism incorporated in an enclosed container, a recess having an action of collecting foreign matter is provided at the inside of the lowest portion of the enclosed container, whereby foreign matter such as worn powder in the enclosed container is greater in specific gravity and is fenced collected in the recess.

According to ~~claim 8~~ another embodiment of the invention, relating to a compressor having a compressing mechanism incorporated in an enclosed container, a muffler

is provided at the discharge part of compressed refrigerant, and a communication path curved in the circumferential direction is provided in the discharge hole of the muffler, a fine pipe is connected to the outside of the communication path, and a collector is coupled to the leading end of the fine pipe, whereby the foreign matter in the discharge refrigerant is separated by centrifugal force, and is collected in the collector through the fine pipe.

According to ~~claim 9~~ another embodiment of the invention, relating to a compressor having a compressing mechanism incorporated in an enclosed container, a fine pipe inclined at 90° or less in the flowing direction of refrigerant is connected to a discharge pipe for discharging compressed refrigerant, and a collector is coupled to the fine pipe, whereby the foreign matter is separated from the refrigerant by the flow of the refrigerant, and is collected in the collector of foreign matter.

According to ~~claim 10~~ another embodiment of the invention, relating to a compressor having a compressing mechanism incorporated in an enclosed container, a fine pipe inclined at 90° or less in the flowing direction of refrigerant is connected to a discharge pipe for discharging compressed refrigerant, the fine pipe is connected to the inlet of a collector, a filter is provided in the collector, a bypass pipe is coupled to the other outlet of the collector, and the leading end of the bypass pipe is coupled with the discharge pipe, whereby the foreign matter in the refrigerant is collected by the filter.

According to ~~claim 11~~ another embodiment of the invention, relating to a compressor having a compressing mechanism incorporated in an enclosed container, the compressing mechanism includes a rotary shaft for transmitting rotation, and an upper bearing and a lower

bearing for supporting the rotary shaft, an oil feed path is provided in the upper bearing and lower bearing for the purpose of lubrication, and a collector inclined at an angle of 90° or less in the flowing direction of lubricating oil and closed at the leading end is provided in the oil feed paths, whereby foreign matter such as worn powder in the refrigerating machine oil is separated by difference in specific gravity, and is collected in the collector.

According to ~~claim 14~~ another embodiment of the invention, relating to a compressor used in refrigerating or air-conditioning system, using chlorine-free hydrofluorocarbon used as refrigerant either alone or in mixture, and packing an enclosed container with refrigerating machine oil compatible with the refrigerant, a motor and a compressing mechanism are disposed in the enclosed container, the compressing mechanism includes a rotary shaft for transmitting rotation of the motor, an oil feed pump is provided in the rotary shaft, a communication hole for feeding refrigerating machine oil to necessary parts is formed, a passage extending downward to the communication hole is provided, and the other end of the passage is closed, whereby foreign matter such as worn powder in the refrigerating machine oil is separated by difference in specific gravity, and is collected in the passage.

According to ~~claim 15~~ another embodiment of the invention, relating to a compressor used in refrigerating or air-conditioning system, using chlorine-free hydrofluorocarbon used as refrigerant either alone or in mixture, and packing an enclosed container with refrigerating machine oil compatible with the refrigerant, a motor and a compressing mechanism are disposed in the enclosed container, the motor includes a stator and a rotor, the rotor has a rotary shaft for transmitting rotation to the compressing mechanism, the rotary shaft

has a oil feed pump, an oil feed path for feeding refrigerating machine oil to sliding parts is further formed in the rotary shaft, the oil feed path and one end of a fine pipe are connected, and the leading end of the fine pipe and a collector provided in the rotor are connected with each other, whereby foreign matter such as worn powder in the refrigerating machine oil is separated by difference in specific gravity, and is collected in the collector.

The ~~claimed invention as set forth in claims 4, 7, and 12 is intended to further enhances~~ the collection of foreign matter ~~collecting effect by disposing a magnetic piece in the collector or the recess acting to collect that collects foreign matter.~~

Thus, by the centrifugal force or flow velocity of refrigerant, the foreign matter in the refrigerating cycle can be separated and collected, and clogging of the throttling unit by foreign matter can be prevented. This action can prevent the spiral of deposit of foreign matter in the throttling unit, decrease in flow rate of refrigerant, rise of compression ratio of refrigerating cycle, elevation of discharge temperature, and promotion of wear of the compressor. Moreover, the reliability of the refrigerating cycle can be enhanced.

(Embodiment 1)

Fig. 1 is a partial longitudinal sectional view of a cooling system in embodiment 1 of the invention. Herein, reference numeral 1 denotes a connection piping, which is provided in a front portion of a throttling unit 2 of a refrigerating cycle. However, the connection piping 1 may be provided also in a rear portion, or in both front portion and rear portion. The connection piping 1 is a coil shaped pipe, and a fine pipe 3 is connected at its lowest position, and a collector 4 is coupled to this fine pipe 3. In this constitution, when the refrigerant flows in the connection piping 1, foreign matter such as worn

powder is guided into the collector 4 through the fine pipe 3 by the centrifugal force. By installing a magnetic piece 5 in the collector 4, the separating effect may be further enhanced. By thus collecting the foreign matter such as worn powder, clogging of the throttling unit 2 in the refrigerating cycle can be prevented, and rise of discharge temperature may be also avoided. Moreover, yet ~~yet,~~ if worn powder is contained in the refrigerating machine oil, abrasion is further promoted in the sliding parts. By removing the worn powder, therefore, progress of wear can be retarded.

(Embodiment 2)

Embodiment 2 of the invention is described below. In Fig. 2, reference numeral 1 denotes a connection piping, which is provided in at least front portion or rear portion of a throttling unit 2 of a refrigerating cycle. A fine pipe 3 is connected to the lower portion of the connection piping 1. The center line of the fine pipe 3 is inclined at an angle of 90° or less in the flowing direction of refrigerant. A collector 4 is coupled to the leading end of the fine pipe 3. Accordingly, when the refrigerant flows in the connection piping 1, foreign matter such as worn powder is guided into the collector 4 through the fine pipe 3 by the flow velocity of the refrigerant, and is separated. The separating effect may be further enhanced by installing a magnetic piece 5 in the collector 4.

(Embodiment 3)

Embodiment 3 of the invention is described below. In Fig. 3, reference numeral 6 denotes an enclosed container of a compressor, and comprises a compressing mechanism 7. A recess 8 is formed in the lowest position of the enclosed container 6. Therefore, foreign matter such as worn powder is collected in the recess 8 by the difference in specific gravity and the force generated in the rotating direction at the time of operation of the

CLAIM MARK-UPS FOR
RULE 53(b) DIVISIONAL
APPLICATION OF SERIAL NO. 09/564,647

12. (Amended) A compressor of claim 8 [any one of claims 8 to 11], wherein a magnetic piece is disposed in the collector.

13. A compressor of claim 8 [any one of claims 8 to 12], wherein hydrofluorocarbon is used as refrigerant, and a refrigerating machine oil compatible with the refrigerant is used.